March 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

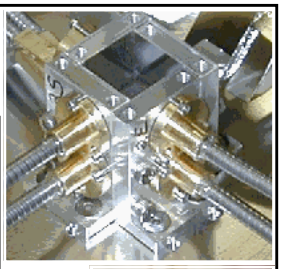

Fig. 1. Square hardware on end of Z transmission line for ICE technique.

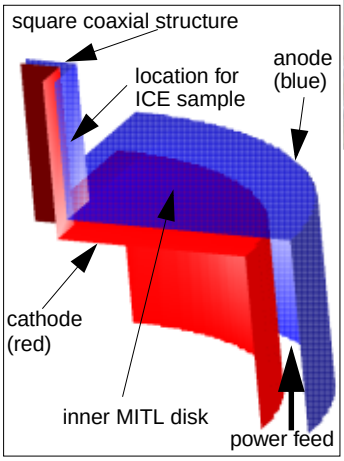

Fig. 2. Hardware as simulated on QUICKSILVER code for higher pressure with ICE on Z.

Fig. 3. Hardware for ZPDH on Z: a) top array and secondary hohlraum, and b) bottom array and primary hohlraum. Part of retaining ring is shown in lower photo.

In isentropic compression experiments (ICE) on Z, current flows through a section of coaxial magnetically-insulated transmission line (MITL) deformed into a square structure (Fig. 1). That geometry (Oct. 99 *Highlights*) has allowed us to obtain, on a single shot, equation-of-state data for 8 material samples (2 on each square surface) at >1 Mbar pressures. Results from the two-dimensional magnetostatics code ATHETA suggest 2 - 5 Mbars might be possible by deforming the end of the transmission line into a narrow rectangular shape. We are using the 3-D QUICKSILVER code (Fig. 2) to develop the hardware design to reach these pressures.

In March we had 12 Z shots: 5 with two separate pinches driving a z-pinch-driven hohlraum (ZPDH), 2 to diagnose the energy delivered to a ZPDH from a single pinch, 3 to diagnose the end-on radiation field produced by a dynamic hohlraum (DH), and short-circuit shots on two days to optimize the long-pulse mode. The short-circuit shots, together with previous ones, have produced a variety of current risetime options for Z: 100, 180, 220, 250, and 300 ns.

Ideally, to radiate a capsule in a ZPDH uniformly, identical top and bottom pinches should provide the radiation drive. In previous experiments two pinches were fed from a single current feed (see Aug. 99 *Highlights*) and the outside diameter of the secondary hohlraum was part of the power flow surface that fed the upper pinch. To assess our ability to drive two completely separate pinches, we designed, built, and tested two independently loaded arrays on Z (Fig. 3) and modified the SCREAMER code to allow for completely independent pinches. The performance is sensitive to even small (50 μm) offsets of the bottom "hangdown" array. The wires in the hangdown array require stronger weights and a retaining ring to hold them in place. However, the temperature in the secondary can be measured without intervening wires.

The three DH shots used a configuration consisting of nested wire arrays and a central foam cylinder. These shots used the most diagnostics ever on Z. LANL requested these shots, and a 4th one in early April, to provide detailed information about the ~230-eV end-on radiation source (see Jan. 99 *Highlights*) before it is used for more weapon physics experiments. The diagnostics to determine the spectral, temporal, and angular distribution of the radiation included a new one: a bolometer/x-ray-diode (XRD) diagnostic that is mounted at 30 degrees. Other diagnostics were transmission grating spectrometers, silicon diode arrays, time-integrated and time-resolved x-ray crystal spectrometers, large-format pinhole cameras, soft-filtered x-ray framing cameras, photoconducting diodes, and additional XRDs and bolometers. On some of the future shots, LANL plans to access the end-on source from both above and below the foam target.

Team Specialty Products broke ground for a new building in the Sandia Science and Technology Park just east of Kirtland Air Force Base. The 11-year-old local firm designs and manufactures electronic and mechanical devices for pulsed power and high voltage applications; Z is one of its main customers.

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